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November 18, 1999

Ms. Runore C. Wycoff, Director
Environmental Restoration Division
U.S. Department of Energy
Nevada Operations Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

RE: Review of the Draft CAU 98 Frenchman Flat Groundwater Flow and Contaminant Transport Model and Source Term Modeling Document

Dear Ms. Wycoff:

The Nevada Division of Environmental Protection (NDEP) has reviewed the Preliminary Draft CAU 98: Frenchman Flat - Groundwater Flow and Contaminant Transport Model comprised of the data documentation packages (Volumes I, II, and III) listed below. This preliminary draft modeling report presents the U.S. Department of Energy's (DOEs) efforts to evaluate the existing data and develop an understanding of flow in the Frenchman Flat area based on these data. The documentation presented demonstrates that there is <u>not</u> an adequate understanding of the Frenchman Flat Corrective Action Unit in order to successfully complete the Corrective Action Investigation. This lack of understanding is primarily due to an insufficiency of data. It is NDEP's determination that DOE cannot

acceptably move forward with the current numerical fate and transport model, or propose a Corrective Action Decision at this time.

Therefore, in accordance with the FFACO, including the UGTA Technical Strategy, and based on current hydrogeologic and modeling practice, it is hereby required that the Frenchman Flat Corrective Action Investigation Plan (FF-CAIP) be revised and amended. The amended FF-CAIP must include provisions for further data collection and analysis. It is expected that DOE will need multiple iterative phases of data collection, each followed by analysis and incorporation of new information with existing data.

In addition, NDEP has concerns regarding the selected model code, modeling approach, and model structure. The modeling code, SWIFT98, must be reevaluated to determine if it is still the appropriate code to be used. The approach taken concerning the use of the Regional Model (RM) to provide boundary conditions must be reconsidered and the size and structure (grid spacing, thickness, etc.) of the model needs to be reviewed to determine if they are appropriate to meet the model objectives. The revised and amended CAIP must also address these modeling issues. However, NDEP does not necessarily expect that a final modeling plan be presented until it is determined that sufficient data exist to determine the proper code and structure.

This letter provides NDEP's comments on the draft model report. This letter further outlines NDEP's preferred path forward for the Corrective Action Investigation within the precepts set forth in the FFACO including the Process Flow Diagram for the Underground Test Area Corrective Action Unit in Appendix VI of the FFACO.

This preliminary flow and transport model was presented to NDEP in three volumes:

1.) Underground Test Area Subproject, Corrective Action Unit 98: Frenchman Flat Data Analysis Task. Volume I - Hydrostratigraphic Model. Documentation Package.

2.) Underground Test Area Project, Corrective Action Unit 98: Frenchman Flat, Volume II - Groundwater Data Documentation Package. Draft. April 1999. Revision No.: 0.

3.) Underground Test Area Project, Corrective Action Unit 98: Frenchman Flat, Volume III - Groundwater Flow and Contaminant Transport Model Documentation Package. Draft. April 1999. Revision No.: 0.

NDEP also reviewed the "Evaluation of the Hydrologic Source Term from Underground Nuclear Tests in Frenchman Flat at the Nevada Test Site: The CAMBRIC Test", UCRL-ID-132300, a supplemental document to the groundwater flow and contaminant transport model. This document details the results of source term modeling performed by Lawrence Livermore National Laboratory. Several concerns arose with regard to the representativeness of the CAMBRIC event within the context of a model for evaluation of all the Frenchman Flat tests. Of additional concern were several of the qualifying assumptions made and the limited model input data in general.

In addition to reviewing the above documents, NDEP has also reviewed the External Peer Review Group's final report, namely, "External Peer Review Group Report on Frenchman Flat Data Analysis and Modeling Task, Underground Test Area Project", prepared for the U.S. Department of Energy, Nevada Operations Office. NDEP's comments in this letter are not intended to lessen, negate, or alter the intent or impact of any of the Peer Review Group's comments. The Peer Review Group's comments should be appropriately addressed.

I . COMMENTS

Comment No. 1 - Insufficient Data

NDEP's primary comment regarding DOE's "Corrective Action Investigation Plan for Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nevada, Revision 1, July 1999" was that insufficient data to produce acceptable levels of confidence in the flow directions and the conceptual model were presented. This lack of data is reflected throughout all steps and processes of the modeling effort.

Examples of the lack of data are as follows:

A. Thickness of Alluvium and Bedrock Interface - There are insufficient data to determine the thickness of the alluvium and the bedrock underlying the alluvium. It is not known whether locations exist at which the alluvium is in contact with the Lower Carbonate Aquifer.

B. Alluvial Aquifer/ Potentiometric Head Data - Existing data for the alluvium only provide water table elevations. The presence of vertical gradients has not been addressed. A series of nested piezometers is required to begin to assess flow in 3-dimensions in the alluvium.

C. Hydrologic Data Below the Frenchman Flat Alluvium - Since there are no holes drilled at depth in Frenchman Flat there are no actual hydrologic data from the units below the Frenchman Flat Alluvium. All the model input data for these units are estimated from measurements taken outside of the basin.

The issue of lack of data is a recurring theme throughout the remainder of NDEP's comments.

Comment No. 2 - Hydrostratigraphic Cross Sections

The hydrostratigraphic cross sections were developed from surface mapping and drill hole information. These stratigraphic cross sections vary in thickness from 5,000 meters to 6,000 meters. The drill holes generally are 200 to 500 meters in depth, while two (2) drill holes (TW-F and UE-5cWW) were drilled to maximum depths of 1036 meters and 817 meters, respectively. Therefore, the drill holes are less than 10 percent of the total thickness of the cross sections.

The construction of cross sections relied heavily on surface mapping. Because of the lack of drill hole data, or even geophysical data to support the cross sections being drawn, the cross sections lack reliable details and unit depths. Since the initial flow modeling process requires an estimate of the thicknesses of the various hydrogeologic units and uses these in the flow calculations, the representativeness of the model is put into question.

Comment No. 3 - Conceptual Model

The conceptual model on which the numerical fate and transport model was based was not a significant improvement over the conceptual model that was presented in the Frenchman Flat Corrective Action Investigation Plan. Several alternative conceptual models could have been postulated over the three that were presented. The flow model results did not serve to either refine the proposed west-to-east conceptual flow model or clearly eliminate any of the alternatives. The conceptual model requires further refinement through data collection before an acceptable numerical fate and transport model can be constructed or a Corrective Action Decision (CAD) can be made.

The conceptual model must be continually revised as part of the iterative process. To build confidence in the flow and transport model requires not only a competently constructed numerical fate and transport model, but also an underlying conceptual model that clearly demonstrates credible understanding of the flow system.

Comment No. 4 - Hydrologic Parameter Data

A major basis for understanding groundwater flow and contaminant transport is an understanding of the direction (both vertical and horizontal components) and rate of the groundwater flow. The necessary data to have this understanding for the Frenchman Flat CAU are lacking. This scarcity of data extends to other important hydrologic parameters such as hydraulic conductivity.

A significant issue with regard to hydrologic parameters concerns a key assumption made in the investigation. The assumption is that hydraulic conductivity decreases with depth. This assertion is totally unsupported.

Comment No. 5 - Flow and Transport Model

Concerns over the CAU-scale model begin with the approach chosen to develop the numerical model. The CAU-scale model was based on and derived from the Regional Flow and Transport Model. Presumably, this was done to compensate for the scarcity of site-specific data. This heavy reliance on

the previous model consequently results in a numerical representation of the flow and transport system which is too large to provide the site-specific analysis required in this CAU investigation. NDEP believes that a smaller-scale analysis should be considered which could lead to development of a flow and transport model which is better able to honor and represent site-specific conditions.

The Regional Flow and Transport Model is used to provide input boundary conditions for the CAU-scale model through a rather cumbersome process. Though utilizing output from a regional simulation to bound a smaller-scale model is a standard modeling practice, NDEP questions whether the execution couldn't have been smoother. This approach for generating input boundary parameters should be reconsidered and streamlined, if possible.

Finally, the limitations of a finite-difference modeling approach become apparent when the complexities of simulating faults and dipping hydrostratigraphic units are considered. The merits of a finite-element model should be reviewed within the context of the predefined requirements established for the modeling code. A finite-element code which meets existing criteria may allow a more representative model of the flow and transport system to be constructed.

Comment No. 6 - Determination of Transport Process

The transport processes, also, were not actually determined due to a lack of Frenchman Flat CAU-specific data regarding dispersivities, diffusivities, interactions of radionuclides and their respective successive daughter products with the pore/capillary walls of the media through which the water beneath the Frenchman Flat CAU flows. Rather, assumptions were made regarding values of model input parameters and model output was generated based on these assumed input values.

Comment No. 7 - Lower Carbonate Aquifer

The Lower Carbonate Aquifer (LCA) is a fractured limestone. However, the LCA appeared to have been modeled as a highly porous unit, rather than modeled as a fracture flow system. This approach does not allow for estimating the flow along the primary fracture zones and dominant flow paths.

Comment 8 - Uncertainty Analysis

The uncertainty analysis, though numerically intensive, does not reflect the true level of model uncertainty. This is due to the limited data used in the analysis and a conceptual model that does not take into account other plausible hydrogeologic scenarios which could influence contaminant movement.

Frenchman Flat CAU-specific data were not used to construct probability density functions (pdfs) for parameters used in the model. Thus, the pdfs used may not reflect the true variabilities found in the field. This has resulted in uncertainty analysis results that may understate the actual level of parameter uncertainty.

A significant contributor to model uncertainty is the uncertainty over the hydrogeologic conceptual model, which may exert considerable influence over contaminant transport. The attempt to quantify uncertainty presented in the report, while at the same time not accounting for the considerable uncertainty in the conceptual model, has resulted in misleading and indefensible conclusions.

Comment 9 - Hydrologic Source Term

The hydrologic source terms for the Frenchman Flat CAU events (CASs) are insufficient. The CAMBRIC event data are insufficient and similar event data have not been presented for the other Frenchman Flat CAU events. Furthermore, actual data delineating the post-event movement of radionuclides in the groundwater have not been presented or used in the model. Thus, a revised and amended CAIP is required to further develop and estimate more substantive information regarding the current location(s), constituents, and their respective concentrations at any event(s) in the groundwater(s) beneath the Frenchman Flat CAU.

Comment No. 10 - LLNL Hydrologic Source Term Report

Given several qualifying assumptions made in the report (ambient temperature of 25°C, low yield detonation, no consideration of colloidal transport among others), NDEP has reservations about the completeness of this analysis.

A question remains regarding the difference between the unclassified CAMBRIC radionuclide source term and the classified results that DOE is expected to provide at a later date to NDEP officials possessing the appropriate security clearance.

II. THE PATH FORWARD

NDEP expects that the path forward in this ongoing investigation begins with a thorough assessment of needed FF CAI activities guided by the above comments, combined with the External Peer Review Group's remarks and recommendations. NDEP encourages DOE to use this initial modeling exercise as an opportunity to gain useful insight into the data gaps and weaknesses that have been pointed out by both parties. DOE should commence to learn from this phase of the work and seek to refine the model and its representation of conditions in Frenchman Flat.

The National Research Council, in its 1990 publication Ground Water Models: Scientific and Regulatory Applications, cites the utility of groundwater models. The Council asserts that model applications are useful tools to: 1) assist in problem evaluation; 2) conceptualize and study ground-water flow processes; and 3) recognize limitations in data and guide collection of new data. We agree with this assessment and remind DOE that a flow and transport model is most powerful when used as a *tool* for understanding the system being investigated, not simply as one-time undertaking used to satisfy the requirements of the FFACO.

DOE should convene meetings of the technical work group responsible for preparing this model (which we understand has already begun) and begin discussions on how to address the concerns outlined in this letter and the External Peer Review Group's report. The technical work group should then make specific recommendations for the collection of additional data.

The path forward may require that the data collection process have multiple data collection steps. NDEP expects that DOE will identify an initial data collection step with possible later data collection steps in the revised and amended FF CAIP prior to conducting additional modeling steps.

An element that needs to be reviewed is whether the two (2) testing areas within Frenchman Flat should be divided in the analysis. Currently, the north and south testing areas have not been distinctly separated.

The areas that NDEP sees as areas of importance for data collection, based on the current understanding of the system are:

1. Define flow directions within and into and out of the alluvium.

2. Define the bottom of the alluvium

3. Determine if the LCA is in contact with the alluvium.

4. Further determine if contaminant transport is occurring within the alluvium from the testing areas.

A major part of determining and conducting the future activities is the continuous process of redefining of the conceptual model(s). The conceptual model must continually be revised and updated. A great disappointment of this initial computer modeling effort was that, due to insufficient data, the conceptual model could not be improved upon. Prior to beginning any evaluation of the next phase of work, the conceptual model(s) will have to be significantly refined.

NDEP hereby establishes a compliance date of February 4, 2000 for submittal of a Draft Addendum to the Frenchman Flat CAIP, detailing the first phase of activities intended to address the identified deficiencies. NDEP also hereby establishes a Deadline of April 24, 2000 for submittal of the Final version of the above Addendum to the Frenchman Flat CAIP.

Questions regarding this matter may be addressed to C. Goewert at (702) 486-2865, C. Case at (775) 687-4670 Ex. 3029, S. Jaunarajs at (775) 687-4670 Ex. 3030, or P. Liebendorfer at (775) 687-6470 Ex. 3039.

Sincerely,

Paul J. Liebendorfer, P.E.
Chief Bureau of Federal Facilities

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